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Visual Cognate Processing in Croatian Speakers of Global English

Cognates are translation equivalents which share similarity of form across languages (e.g. Cro. *problem* and Eng. *problem*). In relation to non–cognates, bilingual speakers have been shown to react to cognates faster (cognate facilitation effect) in the lexical decision task, and slower (cognate inhibition effect) in the language decision task. Postulates of the Bilingual Interactive Activation model + (BIA+) (Dijkstra & van Heuven, 2002) are used in the formulation of hypotheses and the explanation of results in this study. The cognate facilitation effect in the lexical decision task may be accounted for in the BIA+ model by suggesting increased semantic activation levels in cognate processing as opposed to non–cognate processing which occurs due to the shared characteristics of the items belonging to a cognate pair (Lemhöfer & Dijkstra, 2004). In this study, cognate processing of a group of Croatian speakers of Global English is investigated by means of a lexical decision task. Croatian speakers of Global English use the English language (which is *not* their mother tongue) on a daily basis in some aspect of their lives (work, academia, international communication) as well as in their pastime. As English is used as the lingua franca of the modern business world and education, and the number of speakers of Global English is on the rise in Croatia, their language processing needs to be examined and represented in the models of language processing.

In the analysis the interaction of the following independent variables was investigated: language (Croatian / English), word type (word / pseudoword), and cognateness (cognate / non–cognate). The analysis of variance showed a significant triple interaction of language, word type and cognateness. The opposite cognate effect was found in reactions to Croatian cognates as reaction times to Croatian cognates were slower than reaction times to Croatian non–cognates. There was no effect of cognateness found in reaction times to English words and pseudowords, and Croatian pseudowords.

On the basis of the results of this study, an adaptation of the BIA+ model was laid out so as to accommodate the findings related to cognate processing in Croatian speakers of Global English. The significant additions to the BIA+ model involve lateral inhibition of the cognates within the same processing levels, lateral inhibition at the language level which results in the necessity of the participants to perform a language decision prior to performing the lexical decision, and inhibitory influence of the activation of the less proficient language on the mother tongue activation which is reflected in the mother tongue inhibition in the processing.

1 Introduction

In psycholinguistics experimental methods are used to offer researchers insight into the functioning of speakers' minds in the course of language processing. The focus of such research may be twofold; it can provide insight into the organisation of the mental lexicon as well as the procedures involved in lexical access. Mental lexicon can be described as the "storage" of the language(s) a person knows. It comprises all semantic, syntactic, morphological, phonetic and phonological information at a speaker's disposal (Erdeljac, 2009, p. 11). The organisation of the mental lexicon refers to the way linguistic information is stored in the mental lexicon, while lexical access denotes the process of accessing the mental lexicon to retrieve that information. In speakers of more than one language, the issues of the organisation of the mental lexicon and lexical access become more complex. Some related issues are the existence of one or more lexica (one for each language of the speaker), the language–(non)selectiveness of lexical access[1], the processing and storage of cognates, etc. This paper deals with lexical access in bilingual visual cognate processing. More precisely, it deals with the process of accessing the mental lexicon[2] in Croatian speakers of Global English in order to retrieve information on cognates. Cognates are words which have similar form and meaning in two languages (e.g. Cro. *centar* and Eng. *centre*). Due to the characteristics they share between languages, researchers have been particularly interested in such words and the way they are accessed in the mental lexicon of bilinguals. It has been shown that cognates facilitate language processing in bilinguals as they process cognates faster than non–cognates (e.g. Lemhöfer & Dijkstra, 2004; Roberts & Deslauriers, 1999; Sherkina–Lieber, 2004). This effect has been termed the *cognate facilitation effect*.

The term Global English is used in this paper to refer to English as the language of globalisation used by speakers all over the world, who use it for the purposes of work, education and international communication (Graddol, 2006). The distinctions between using English for communication with native and/or non–native speakers is not made here. Croatia belongs to the expanding (outer) circle countries according to Kachru's (1997) division of English language speakers. In other words, it belongs to those countries in which English is recognized as an important means of international communication, although it is neither the mother tongue of the citizens (the inner circle), nor is Croatia one of the former British Empire colonies (the outer circle). Although English is learned as a foreign language in Croatia, Croatian population is very much

1 In bilingual language processing, the *language non–selective access hypothesis* predicts parallel activation of lexical candidates from both languages of the speaker upon the presentation of the stimulus item. *The language selective access hypothesis* predicts that only the lexical candidates of the target language are activated upon the presentation of the stimulus item.

2 The existence of one or two mental lexica is not an issue discussed in this paper and is not relevant for this study. In this paper the existence of only one mental lexicon comprising the linguistic information of both languages of the speakers will be assumed.

exposed to it through media (TV, the Internet) and the necessity to know and be able to use it is very much present and felt. Due to this exposure and positive attitudes to English, one could say that it is easier to learn English than to learn another foreign language in Croatia as English is supported in the environment. Moreover, Croatian is being permeated with English words such as the words *stick* (USB stick), *file, slide* (PowerPoint), *event*, *bestseller*, *limit*, etc. Some of these words are mostly used in spoken Croatian (e.g. *stick*) and some are present in their written form, often in the media (e.g. *event*). This paper deals with those Croatian–English cognates (and their counterparts in English) which had been recognized as integral to the Croatian language[3] by 1977. The Croatian frequency dictionary (Moguš, Bratanić, & Tadić, 1999) was used as the reference in stimulus selection and the last addition in the texts used for the corpus of the Croatian frequency dictionary was made in 1997.[4] Some of the modern permeations from English which occurred after the time of Moguš et al.'s corpus selection may be considered potential cognate candidates in the vocabulary of the Croatian speakers of Global English and they might experience a similar future of integration into the language of the speakers who comprise the focus group of this study. So, the findings related to the processing of the pre–1997 cognates in the Croatian speakers of Global English may provide some insight into the future of the processing of the new cognates in this speaker profile.

Croatian speakers of Global English are Croatian dominant bilinguals who use English for the purposes of education, work, and international communication as well as pastime. They are people (often, but not necessarily, young people) who are IT literate and use English for the purposes of obtaining information and communicating with peers globally. They have mostly started learning English in primary school (usually at the age of 9 or earlier) and have been very much exposed to English encountered in their environment in Croatia, through music, TV programmes (some of which are available only in English), etc. It has been suggested that the precise description of Croatian speakers of Global English lies at the intersection of three definitions of speakers of English: speakers of English as a foreign language (EFL), speakers of English as a second language (ESL) and bilinguals (Cergol Kovačević, in print). While EFL speakers learn English in formal settings and do not use it in their

3 It is not suggested here that the cognates used in this study are necessarily borrowings from English into Croatian. They may have had a different language contact path of penetrating both English and Croatian and are currently felt to be integral to both these languages. In fact, most of the words used for the Croatian cognate stimulus are of Greek, Latin and French origin (Klaić, 1980). This paper does not venture into how these words became cognates in the two languages. However, it can be suggested that, once the modern penetrations from English into Croatian are felt to be integral to the Croatian language, the mechanisms involved in their processing will resemble the processing of the cognates studied in this paper.

4 One exception made in the stimulus selection is the inclusion of three cognates which belong to the English stimulus and whose Croatian cognate pairs are not listed in the Croatian frequency dictionary. These are the English words *colour* (Cro. cognate pair *kolor*), *future* (Cro. cognate pair *futur*), and *leader* (Cro. cognate pair *lider*).

environment, ESL speakers acquire and use English in their environment (Jelaska, 2005). Bilinguals use both languages regularly and actively in their everyday lives (Grosjean, 1998). Speakers of Global English are described by means of an overlap between these three definitions as EFL–like speakers who start learning English in a formal institutionalised setting (school, language course, kindergarten), they use it and continue to learn and acquire it in their environment (in academia, at work and free time) as ESL speakers do, and they are proficient Croatian dominant bilingual speakers (level C1 or higher) who use English regularly in their lives. As such a profile of English speakers is on the increase due to globalisation, their language processing with its potential specificities needs to be investigated. The purpose of this paper is to collect information on cognate processing in Croatian speakers of Global English and add it to the body of world literature dealing with cognates. Some predictions will be made on the future processing of the post–1997 potential cognate candidates. The localist connectionist framework will be employed. The results of the study will be represented in an adapted version of the Bilingual Interactive Activation model + (BIA+) (Dijkstra & van Heuven, 2002).

2 Localist interactive connectionist framework – bilingual processing

Connectionist models present complex networks consisting of simple processing units. When activated, each unit spreads activation onto its neighbouring units. The units are layered into several processing levels: input units, output units, and "hidden" units which are positioned in between the input and output units (Christiansen & Chater, 2001). As opposed to the popular *feed–forward* connectionist network in which activation flows in only one direction, the theoretical framework of this paper is based on the *interactive activation* type of network which predicts the spread of activation (and inhibition) in two directions: bottom–up and top–down. The benefit of such an activation flow is the fact that it involves lexical and non–lexical (context) processing, which is characteristic of natural language perception.

There are two main approaches to bilingual language processing established within the interactive connectionist framework: *localist* and *distributed* models. The main difference between these two types of models is in their view and representation of the role experience has in linguistic behaviour. While distributed models focus on the changes brought about by learning, localist models study language processing at one point in time only, without taking into account the changes conditioned by learning. In other words, they deal with "the processing structures of an adult bilingual" (Thomas & van Heuven, 2005, p. 202).

As the focus of this study is on bilingual visual language processing at one point in time, the theoretical background of this paper builds upon the *localist interactive connectionist models* focusing on bilingual visual processing of two languages. A widely cited localist interactive connectionist model is the model of bilingual visual language processing originally presented as the Bilin-

gual Interactive Activation (BIA) model (Dijkstra & van Heuven, 1998), which was later extended to include the levels of lexical and sublexical activation of phonology and redesigned into the Bilingual Interactive Activation model + (BIA+) (Dijkstra & van Heuven, 2002). As the BIA+ model predicts parallel activation of both languages at lexical and sublexical levels of orthography and phonology in languages with similar orthographies, it accounts for the predictions of the language non–selective access hypothesis to the bilingual mental lexicon. Information flows bottom–up, presuming the level of sublexical orthography as well as the matching level of sublexical phonology (which gets activated despite the fact that visual stimulus is being processed). Next are the level of lexical orthography and the matching level of lexical phonology. The activation between the parallel levels of orthography and phonology is lateral. Finally, there are the semantic and language levels. Such a word identification system provides output to the task/decision system, but the task/decision system has no effect on the activation state of words. On the basis of the input received from the identification system, the task/decision system specifies the processing steps needed for carrying out the task at hand and makes decisions on when the response needs to be made. While linguistic context (the preceding word or sentence) has direct influence on the processing, the non–linguistic context (task requirements, instructions, and participants' expectations of the language of processing) influences the processing only indirectly, via the task/decision system (Dijkstra, 2005).

3 Cognates and bilingual cognate processing

Cognates have been defined somewhat differently across studies as words which have similar form and meaning in different languages (Yule, 2006, p. 238), words which have a common ancestor (Crystal, 1997, p. 294), "opportune translation equivalents that sound highly similar across two languages" (Blumenfeld & Marian, 2005, p. 286), etc. Since it is difficult to imagine that speakers would think about the etymology of words at the moment of using them, and since the focus of this paper is on the study of mental processes at the moment of language use, the definition proposed by Carroll (1992) will be used for the purposes of this paper. Carroll defines cognates as lexical units from different languages which speakers of those languages consider as "somehow being the same thing" due to the similarity of their form and meaning (Carroll, 1992, p. 93). So, a speaker of Croatian and English will sense that the Croatian word *centar* is "somehow the same thing" as the English word *centre*. In languages which use the same script (as Croatian and English do when the language–specific letters are excluded[5]) visually identical cognates

5 Language–specific letters are those letters which occur in one, but not the other language studied. The rest of the alphabet may be the same. In the Croatian–English language combination Croatian language–specific letters are č, ć, đ, š, ž, and English language–specific letters are q, w, x, y. Language–specific letters can be employed as orthographical cues for the election or activation of forms specific to that language stored in the mental lexicon.

can be found, but it can be difficult to find cognate pairs which are *phonologically* identical across two languages (e.g. Cro. /'hotel/ and Eng. /ˌhəʊ'tel/), especially if the languages are typologically very different as Croatian and English are. Also, cognates do not have to be visually identical. De Bot et al. (1995) introduce the term *semi–cognates* for those cognates which have similar but not identical form and meaning (e.g. Cro. *centar* and Eng. *centre*). It has been shown that bilingual speakers process both cognates and semi–cognates faster than control (non–cognate) words (Lemhöfer & Dijkstra, 2004). The *cognate facilitation effect* is regularly found in the lexical decision task.[6]

Lemhöfer & Dijkstra (2004) suggest that the BIA+ model may accommodate the cognate facilitation effect by predicting parallel activation of the orthographic (and the corresponding phonological) representations related to the stimulus (e.g. the English–Croatian cognate *film*). Both active representations further activate their (partially shared) semantic representations and in turn receive positive feedback from the semantic node. The activation of both language representations increases the overall activation and so the recognition level is reached more quickly than in the processing of non–cognates. Such predictions of the model have been confirmed by Lemhöfer & Dijkstra (2004) who obtained cognate facilitation effect in Dutch–English bilinguals' reaction times to visually presented cognates in the English language–specific and generalized lexical decision tasks (Experiments 2 and 4 in the study). The BIA+ model is used in this paper as it allows for a detailed disintegration of the levels of bilingual processing; it incorporates phonology as well as semantics necessary in the explanation of cognate processing. Moreover, it allows for the representation of the top–down influence of the task/decision system as well as the language node level, which will prove crucial in the representation of the cognate processing in Croatian speakers of Global English.

Cognate processing is task dependent. In the lexical decision task, participants react faster to cognates than to non–cognates (the cognate facilitation effect). On the other hand, in the language decision task,[7] in which speakers are required to decide which of their two languages a given word belongs to, cognates are processed more slowly than controls. This is known as the *cognate inhibition effect* (Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010). The increased semantic activation conditions faster response times on the lexical decision task and slower response times on the language decision task. Dijkstra et al. (2010) have established the appropriateness of the account lo-

6 In the (visual) lexical decision task participants are presented with strings of letters which comprise either existing or non existing words (pseudowords) in their language. (They can be presented with phonotactically impossible nonwords (e.g. *yxzh*) as well.) The participants need to respond (usually by pressing the specified keys on the keyboard) as quickly and accurately as possible to say whether the visual input is an existing word in their language or not. In the *generalized lexical decision task* participants who speak two languages are required to decide whether the input string is a word in either of their two languages.

7 The language decision task differs from the lexical decision task in that in the language decision task the participants need to decide which language the stimulus belongs to, while in the lexical decision task, they need to decide if the string of letters/sounds is an existing word in their language(s).

calist models offer for the processing of cognates and semi–cognates on the basis of the lexical decision task, language decision task, and the progressive demasking task[8] with cognates. They found the cognate facilitation effect in the lexical decision task, which was highest for identical cognates and decreased discontinuously in semi–cognates. The localist connectionist models predict such a pattern of results due to the lateral inhibition occurring between the same level layers in the two languages. The lateral inhibition is zero for identical cognates and it increases for any mismatching (semi–cognate) input. However, it increases rapidly when cross–linguistic similarity changes from complete equivalence to near–complete equivalence. In language decision (the decision–making process of attributing an item to a particular language) the underlying lexical activation patterns are the same as in the lexical decision (the process of deciding if a letter string presented to the participants is a word in their language(s) or not). However, the response in language decision is slower due to the lateral inhibition occurring between the language membership nodes. Finally, in the progressive demasking task, the authors have found a facilitating effect of semantic similarity but no effect of orthographic similarity (Dijkstra et al., 2010).

Apart from cognate (word) processing, the question of pseudocognate[9] processing arises in contrast to the processing of their nonpseudocognate counterparts. As localist models interpret the cognate facilitation effect by predicting that both readings of the cognate converge at the semantic level causing more semantic activation in the lexicon for cognates than for non–cognates, an interesting question is how letter strings similar to cognates but with no semantic information (i.e. pseudocognates) are processed. Does the similarity of form with the existing words in the two languages speed up reaction times (RTs) and is there an attempt made to access any potential (although nonexisting) semantic information in the process of pseudoword processing? If there were such an attempt, the influence of the potential semantic information would be more prominent in the case of pseudocognates than the non–cognate pseudowords. In that case, RTs to pseudocognates would be different than RTs to pseudononcognates[10].

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8 In a progressive demasking task, which is used to study visual word recognition, participants are presented with target stimulus and a mask consisting of a string of hash marks (###) alternatively on a number of cycles. The presentation duration of the target stimulus is prolonged progressively, while that of a mask is shortened. Participants are required to signal when they have recognized the word by pressing a designated key on the keyboard. RTs in milliseconds are measured. The participants need to write down the recognized word (Dufau, Stevens, & Grainger, 2008, p. 34).

9 The term *pseudocognate* is used for pseudowords (non–existing words) which have originated from cognates. In this study, they were designed by replacing one letter in the cognate with another differing from the original one in four distinctive features.

10 The term *pseudononcognates* shall be used in this paper for the control pseudowords in order to emphasize their lack of connection with the cognates.

4 Research Aim and Methodology

The aim of this paper was to study lexical access in visual processing of cognates in Croatian speakers of Global English. It is expected that the quality of cognateness will influence response times differently depending on whether it occurs in words or pseudowords in both English and Croatian. RTs to cognate words are expected to be faster than RTs to non–cognate words in responses to both Croatian and English words. In the case of pseudowords, no difference between pseudocognates and pseudononcognates is expected in responses to either Croatian or the English stimulus as pseudowords carry no semantic information the activation of which could be increased in the case of cognates, thus conditioning faster RTs. Finally, due to the increased activity of semantic information in cognate processing, fewer errors are expected in responses to cognates than to non–cognates. Due to the predicted lack of semantic activity, there should be no difference between the number of errors in pseudocognates and control pseudononcognates.

4.1 Participants and task

The participants of this study were 64 Croatian speakers of Global English. They were all university students studying to become generalist teachers with a qualification to teach English. Students of this profile use English on a regular basis as one part of their studies which refers to their future general teaching profession is carried out in Croatian, while English is the focus and instruction means of that part of their studies in which they are trained to become teachers of English. Hopefully, they will also use English in their future profession. Moreover, they all reported using English in their free time. They have started learning English in institutionalized settings at the age of 9 or earlier. Before the experiment, they were tested with the Oxford Placement Test (Allan, 2004) by means of which they were placed at level C1 or higher according to the specifications given in the Common European Framework for Languages (Council of Europe, 2001). They have command of all four language skills in the English language.

The participants carried out a generalized visual lexical decision task in which they were presented with cognates, non–cognates, pseudocognates and pseudononcognates in a randomized order. The design of the experiment was complex, completely dependent, with three independent variables (2x2x2): language (Croatian/English), word type (word/pseudoword), and cognateness (cognate/non–cognate). The participants were instructed to decide whether the input string was a word or not by pressing keys "1" and "2" on the keyboard. Half of the participants pressed key "1" for word and "2" for nonword and for the other half the keys were reversed to avoid the influence of the more dexterous hand on the responses. After the instructions had been given in both Croatian and English, the participants were presented with a practice session followed by the experimental session. The presentation of each stimulus was preceded by a fixation sign which lingered in the middle of the screen for 1000 ms. The participants were instructed to look at the fixation which was followed by the target stimulus. Stimuli were presented in random order

in black Courrier New 18 font and they remained on the screen until the participant pressed any of the two designated keys. Reaction times in milliseconds were measured. The experiment was designed and data collected with the E-prime psychological software for generating experiments (Schneider, Eschman, & Zuccolotto, 2002).

4.2 Stimulus

The stimulus used in the research consisted of 12 cognates, 12 non–cognates, 12 pseudocognates and 12 pseudononcognates both in Croatian and English so that the total number of stimuli used amounted to 92 items (Tables 1 and 2). Fifteen additional words and pseudowords in Croatian and English were designed and used in the practice session. Such a high number of practice items was used purposefully to avoid the practice effect because participants were not used to carrying out a lexical decision task. The category of cognates consisted of both cognates and semi–cognates.

The following controls necessary in the lexical decision task were taken into consideration in stimulus design: word class, word length (in syllables and letters), word frequency, word familiarity, orthographic neighbourhood size[11], language–specific orthographic cues. Bi–syllabic 5–8 letter long nouns with a frequency of 100 or more per million were used for the stimuli. These frequencies were checked in Moguš et al. (1999) for Croatian and Leech, Rayson, & Wilson (2001) for English. Only highly frequent words were used for the purpose of avoiding the effect of different stimulus frequencies on response latencies in the lexical decision task. Several weeks prior to the experiment, the participants had carried out a word familiarity test. Only the most familiar words were used in the experiment to avoid the effect of different word familiarity on response latencies in the lexical decision task. The size of the orthographic neighbourhood was controlled both within each language and across the two languages. The items did not contain any language–specific cues and the control words were orthographically and phonotactically legitimate in both languages. In other words, each control word in the English language did not contain any deviations from the orthographical and phonotactical norm of the Croatian language which could possibly direct the processing to the appropriate language. The same was true for the Croatian stimulus with reference to the norms of the English language. The pseudowords were designed by replacing word–initial letter/phoneme which differed from the original one in four distinctive features. The four feature difference was chosen as it was considered large enough to produce a significantly different word while it still allowed for the design of pseudowords which followed the necessary criteria. The distinctive feature tables for Croatian (Erdeljac, 1991) and English (Cergol, 2011) were used. In order to be able only to look at the activation of the potential formal and semantic information and avoid differences in reaction

11 Orthographic neighbourhood of a word consists of all the different words that can be generated by changing only one letter in the target word and keeping the positions of all the other letters (Grainger, O'Regan, & Jacobs, 1989, p. 189) (e.g. *cat, mat, cut, cab*).

times to pseudocognates due to the increased number of cross–language orthographic neighbours (pseudo)cognates may have (Andrews, 1997), the size of the orthographic neighbourhood of the pseudowords was controlled so as not to exceed three orthographic neighbours. Since most cognates used in the study were not orthographically identical across the two languages, cognates and their corresponding pseudocognates did not share the same neighbourhood in Croatian and English.

Table 1 List of Croatian stimuli

		words		pseudowords	
		non–cognates	cognates	non–cognates	cognates
CROATIAN	1	glava	sistem	flava	bistem
	2	prozor	problem	frozor	kistem
	3	slika	motor	blika	votor
	4	pogled	proces	nogled	frupa
	5	miris	grupa	kiris	dotel
	6	sunce	hotel	bunce	lotel
	7	narod	doktor	karod	hoktor
	8	korak	organ	sorak	dagon
	9	kamen	program	vamen	magon
	10	sapun	vagon	rapun	sanka
	11	pokret	banka	lokret	laktor
	12	cesta	karta	hesta	gaktor

Table 2 List of English stimuli

		words		pseudowords	
		non–cognates	cognates	non–cognates	cognates
ENGLISH	1	people	problem	zeople	finute
	2	level	interest	deature	linute
	3	evening	centre	feasure	zinute
	4	feature	minute	zeasure	loment
	5	measure	moment	lupil	zoment
	6	pupil	detail	mabour	fetail
	7	labour	future	pabour	muture
	8	number	colour	fember	puture
	9	member	leader	suilding	meader
	10	building	music	manguage	peader
	11	language	speaker	forning	fusic
	12	morning	figure	lorning	migure

5 Results and Discussion

The analysis of variance was carried out with the reaction times (RTs) of the correct responses. RTs were measured in milliseconds. As expected, the main effect of language was found. RTs to Croatian stimuli were faster than RTs to the English stimuli ($F = 73.44$; $df = 1/63$; $p<0.01$). There was also the expected main effect of word type found as RTs to words were faster than RTs to pseudowords ($F = 46.53$; $df = 1/63$; $p<0.01$). An interaction between language and cognateness was found ($F = 5.17$; $df = 1/63$; $p<0.01$). RTs to cognates were slower than RTs to non–cognates in responses to the Croatian stimulus. There was no difference in RTs to cognates and non–cognates in responses to the English stimulus. A significant triple interaction of language, word type and cognateness was found ($F = 5.08$; $df = 1/63$; $p<0.01$) (Figures 1 and 2). In responses to the Croatian stimulus, RTs to cognates were slower than RTs to non–cognates, while there was no difference in RTs to pseudocognates and pseudononcognates (Figure 1). In responses to the English stimulus there were no differences found in RTs to cognates and non–cognates, nor to pseudocognates and pseudononcognates. To both cognates and non–cognates RTs were faster for words than for pseudowords (Figure 2). In other words, the quality of cognateness influenced RTs to Croatian words and pseudowords differently (slower RTs to cognates than to non–cognates and no difference in RTs to pseudocognates and pseudononcognates). In English, the pattern of results was the same for words and pseudowords (no difference in RTs to both cognates and non–cognates and pseudocognates and pseudononcognates).

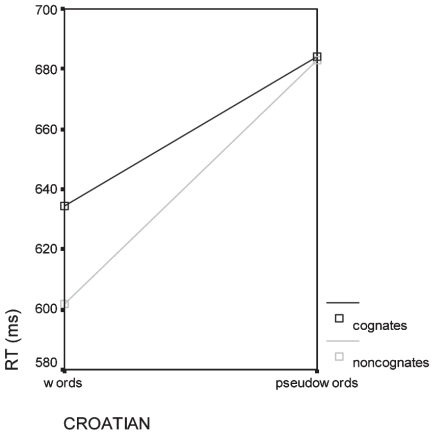

Figure 1 Processing of Croatian word and pseudoword cognates and non–cognates

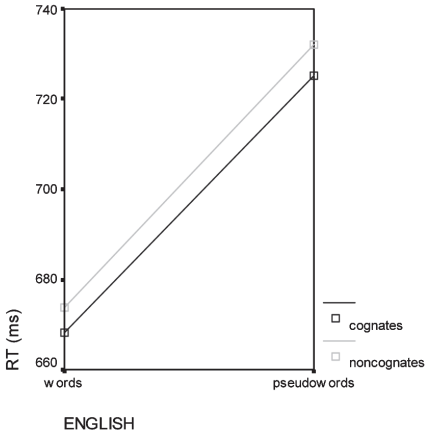

Figure 2 Processing of English word and pseudoword cognates and non–cognates

Despite the small percentage of errors[12] (1.94 %), they were analyzed with the purpose of finding out whether there were any differences in the number of errors between cognates and non–cognates in all conditions. Wilcoxon Signed Ranks test was performed. Although there were no statistically significant differences found in the number of errors in reactions to Croatian cognates and non–cognates ($Z = 0.808$; $p<0.419$), English cognates and non–cognates ($Z = 0.363$; $p<0.717$), Croatian pseudocognates and pseudononcognates ($Z = 0.000$; $p<1.000$), and English pseudocognates and pseudononcognates ($Z = 0.310$; $p<0.757$), a secondary analysis showed a statistically significant difference in error numbers in responses to Croatian and English pseudowords, cognates and non–cognates. In both of these conditions the number of errors to English pseudowords was higher than the number of errors to Croatian pseudowords ($Z = 2.863$; $p<0.05$ for cognate pseudowords and $Z = 2.551$; $p<0.05$ for non–cognate pseudowords).

6.1 Opposite cognate effect

The analysis shows some unexpected and rather striking results. It was expected that RTs to cognates would be *shorter* than RTs to non–cognates for both English and Croatian stimulus. While there was no difference found between RTs to cognates and non–cognates in the English stimulus (*no effect*), in Croatian RTs to cognates were *longer* than RTs to non–cognates. To differentiate this effect from the *cognate inhibition effect* reported to have been found in reactions to cognates in the language decision task (Dijkstra et al., 2010) in this paper the unexpected effect in the lexical decision task is referred to as the *opposite cognate effect* (also Cergol, 2011).

The possible cause of the differing result patterns in the two languages will be discussed first. Both identical cognates and semi–cognates were used in the experiment as previous studies had reported cognate facilitation effects for both of these types of stimuli (although such effects varied for the semi–cognates). Having found results which conflict with the results of previous studies, the stimulus design was re–evaluated in search of any details which would account for the differences in the result patterns. There were 5 identical cognates in the Croatian stimulus and 2 in the English stimulus. A post–hoc[13] orthographic similarity analysis was carried out on the basis of the formula presented by Dijkstra et al. (2010), which was somewhat changed to allow for the cross–language differences. The matching letters which were in the same position in both cognates of the pair were counted. The letters which deviated thus differing the cognate from its cognate pair were also counted and one negative point was assigned to each such letter (as well as an extra letter or an empty space where a letter should be). The number of mismatches

12 In the lexical decision task there is only one source of error: responding that a stimulus is a word when it is not and the other way around.

13 Post–hoc analysis involves looking at the data after the experiment has been performed and results obtained. The purpose of the post–hoc analysis is to uncover any issues or patterns that were not previously specified and which might have influenced the results.

was substracted from the number of matches. This number was then divided by the mean number of all the letters in both items in the cognate pair. The number thus achieved was the *orthographic similarity coefficient (OSC)*. For example, the OSC calculation procedure for the Croatian cognate *sistem* which differs from its English counterpart *system* in 1 letter (*y*) and has 5 matching letters (*s_stem*) is the following: 5 (matching letters) – 1 (mismatching letters) = 4 / 6 (mean number of all the letters in both cognates) = 0.67 (OSC). Such a calculation has shown that the overall OSC[14] for the Croatian stimulus was 9.00, while it was 7.05 for the English stimulus. In other words, Croatian words bore *more* orthographic similarity to their English counterparts than the English words to their Croatian counterparts. This could have caused an effect of language–selectiveness in lexical access of the English cognates (accessing the English elements in the mental lexicon), yielding no difference in RTs to English cognates and non–cognates on a larger scale. On the other hand, such an effect would not be so prominent for the Croatian stimulus, yielding language–nonselective lexical access (accessing elements of both languages in the mental lexicon), which can be manifested in the cognate effect (be it facilitatory or opposite cognate effect).

Apart from the differences in the overall OSCs of Croatian and English stimuli, the differing result patterns can also be explained in terms of the differences in the processing difficulty of the mother and nonmother tongues. Meuter & Allport (1999) showed that in a bilingual naming task, in a switch condition[15] RTs to the stimuli presented in the more proficient language were longer than RTs to the stimuli presented in the less proficient language. The authors explained this "paradoxical" asymmetry "in terms of differences in relative strength of the bilingual's two languages and the involuntary presence of the previous language set across an intended switch of language" (Meuter & Allport, 1999, p. 25). In other words, it took more energy to suppress L1 to allow for the processing of the nonmother tongue. This inhibition can persist in the course of the processing of the mother tongue as "negative priming" of the L1 lexicon (Meuter & Allport, 1999). This "paradoxical" asymmetry may account for the prominence of the opposite cognate effect found in responses to the Croatian stimulus in the present study and the lack of the effect in the responses to the English stimulus, the facilitated processing of which may be accounted for by the "positive priming" of the English language. In other words, the interpretation of the Croatian cognates seems to have tended towards the interpretation of the input as if it was English stimulus due to the cognitive effort invested into the processing of the nonmother tongue, keeping it active throughout the process. Kroll, Michael, & Tokowicz (2002) found that in pre-

14 The overall OSC is the sum of all the OSCs of all the stimuli used. A higher overall OSC of a cognate from one language indicates greater orthographic similarity with the cognate counterpart from the other language.

15 The switch condition is the moment in which the change of the language of processing place. For example, if the visual processing is being carried out in English, the switch condition is the moment in which the language of the stimulus and consequently the language of the processing changes to Croatian.

senting and reacting to the stimulus in the mother tongue, the presence of the vocabulary of the nonmother tongue was sufficient to activate the weaker nonmother tongue to the level at which it had inhibitory influence on the processing of the mother tongue. Kroll et al. (2002) investigated cognate processing of English(L1)–French(L2) speakers. The participants were divided into two groups according to the number of years they had studied French (3 years of study and 8 years of study). As in the present study, they have found slower RTs to cognates than to non–cognates in L1 for the less proficient speakers (3 years of L2 study). In L2 RTs to cognates were faster than to non–cognates. In a group of more proficient speakers (8 years of study) the authors have found the same result pattern, but it was much smaller and barely significant. The authors interpreted such results by concluding that with a higher proficiency in L2, reliance on the lexical form is reduced (Kroll et al., 2002). It seems that the opposite cognate effect in L1 and the overall reduced (facilitatory or opposite) cognate effect (as found in responses to English cognates in the present study) are characteristic of speakers of a more proficient L2 (as are the speakers of Global English). Despite the fact that proficient L2 speakers rely less on lexical form than do more proficient speakers, the similarity of form may activate the representation from the other language which then has a competitive effect on the processing (in terms of "paradoxical asymmetry"). It seems that language decision needs to be performed before lexical decision can be carried out. One will recall that RTs to cognates in language decision task are slower than RTs to non–cognates (Dijkstra et al., 2010); hence the longer RTs to cognates in the processing of which language decision had to precede lexical decision. In the present study the experimenter discussed any potential processing issues with the participants after they had carried out the experiment. They reported that they were conscious of the need to decide which language the cognates belonged to in order to perform the lexical decision task. Although they were required to carry out the lexical decision task by responding to the question "is this a word in Croatian or English?", the participants reported that when they encountered cognates, they asked themselves the question "which language does this word belong to?" In other words, when faced with ambiguity in the target stimulus, they had to carry out language decision first (although this was not the requirement of the task) in order to carry out lexical decision. This process was reflected in longer RTs to cognates in the lexical decision task.

No difference in RTs to pseudocognates and pseudononcognates was found, confirming no influence of the similarity of form and no attempt at semantic activation in the case of pseudowords. There was no difference found in the number of errors between cognates and non–cognates despite the increase in the semantic activation predicted by the localist models. However, it needs to be stressed that the small percentage of mistakes did not allow for a reliable analysis. Finally, the increased level of the familiarity of form seems to have played a role in the processing, allowing fewer errors in responses to Croatian pseudowords than to English pseudowords.

6.2 Adaptation of BIA+ model to cognate processing in Croatian speakers of Global English

The results of this study can be incorporated into the BIA+ model provided some adaptations are performed. First is the lateral inhibition of the cognate pairs between the same level layers in the two different languages. The second one is the existence of the lateral inhibition between the language nodes. Lateral inhibition in semi–cognate processing has already been proposed by Dijkstra et al. (2010). The final adaptation refers to the top–down inhibitory influence of the English language activation which conditions inhibition of the mother tongue. In modelling visual cognate processing in Croatian speakers of Global English, three obligatory levels of processing in a localist interactive activation type of network need to be set (Figure 3[16]). The linguistic information flows bottom–up, but there is also the top–down influence of the task requirements for the performance of which both English and Croatian need to be activated in turns (depending on the language of the stimulus), with English exerting inhibitory effect on the processing of the Croatian stimulus. As in the BIA+ model, first is the level of prelexical orthography common to both languages, at which letters comprising orthographically similar stimuli converge. The letters from the stimulus are activated and the other letters inhibited. The activation of units which can be matched to the visual input from both languages is parallel. Phonological information from both languages is activated as well (the level of sublexical phonology), despite the fact that the input is only visual, and "non–target language spelling–to–sound correspondence rules cannot be suppressed even when they hinder performance" (Dijkstra, Grainger, & van Heuven, 1999, p. 499). Next is the level of lexical orthography at which orthographically similar stimuli are identified as separate and competing lexical items. It is matched with the level of lexical phonology. The activation flow between the levels of orthography and phonology (both prelexical and lexical) is lateral. The identified lexical units from both languages are activated and the others are inhibited. The role of semantics is present already at this early stage of processing. It speeds up RTs to words and slows down RTs to pseudowords. The lack of semantic information renders pseudowords insensitive to their similarity to cognates or non–cognates. When semantic information is absent, the similarities of form help reach correct decisions for mother tongue pseudowords. However, the built up semantic information for Croatian cognates does not facilitate their processing in Croatian speakers of Global English. There is lateral inhibition of the cognate pairs between the same lexical level layers in the two different languages. The course of their processing needs to be decided on at the next level. At the third level, the language level, language decision needs to be performed in order for the lexical processing of Croatian cognates to be completed. The response in language decision is slower due to the lateral inhibition occurring between the language membership nodes. The top–down activation of Global English facilitates the processing of English cognates rendering the processing more language–selective and spreading inhibition over the mother tongue.

16 The model presented in this paper is based on the BIA+ model (Dijkstra & van Heuven, 2002) and the model of Croatian–English language processing (Cergol, 2011).

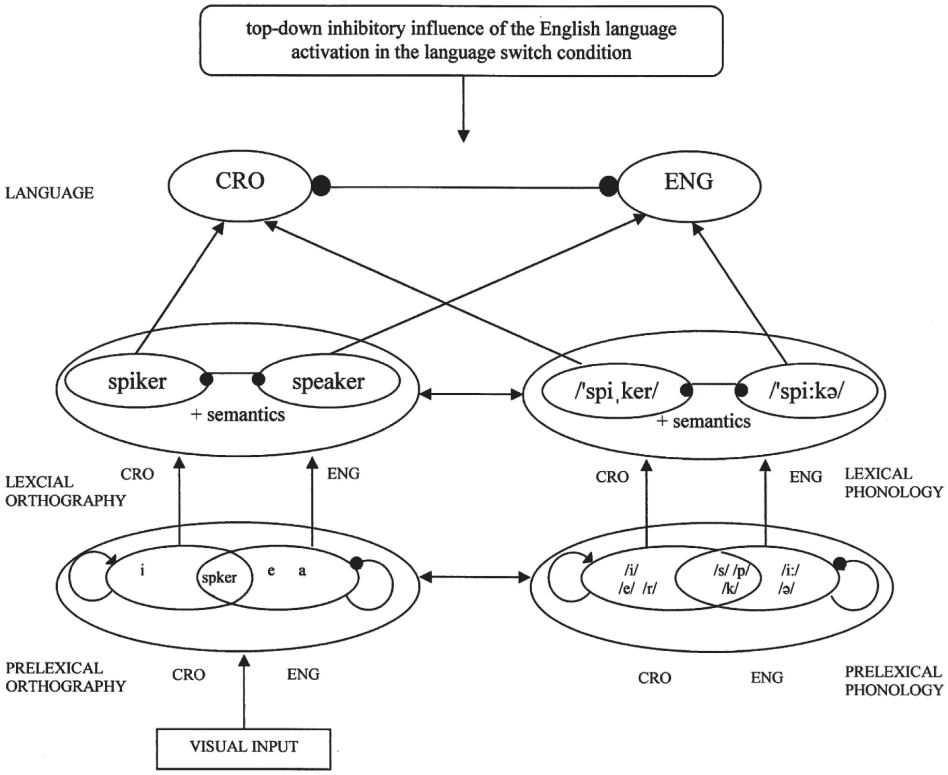

Figure 3 Cognate processing in Croatian speakers of Global English (→ marks activation flow, ● signifies inhibition)

8 Conclusion

This study set out to investigate cognate processing in Croatian speakers of Global English. The main finding of the study was the *opposite cognate effect* achieved in longer RTs of the responses to Croatian cognates as opposed to their non–cognate counterparts, while there was no difference found in the processing of English cognates and non–cognates. The difference in the result patterns observed between the two languages was accounted for by the stimulus design as well as the different top–down influence of the activation of the English language which could have spread an inhibitory priming effect on the Croatian features. No difference in RTs between pseudocognates and pseudononcognates was found due to the lack of semantic activation in the pseudoword processing, and there were no differences in the error rates to the cognate and non–cognate stimuli found, possibly due to the small percentage of errors. The BIA+ model was adapted to account for the processing of cognates in Croatian speakers of Global English. The crucial finding is that

language decision needs to be carried out before lexical decision can take place. Such a deviation in the lexical processing of cognates in Croatian speakers of Global English prolongs RTs, and thus causes the *opposite cognate effect*. A repeated study should employ only form–identical cognates in order to avoid potential influence of the orthographical dissimilarity of semi–cognates on the processing. A topic for further investigation is the storage of cognates in the mental lexicon of Croatian speakers of Global English. The opposite cognate effect suggests that cognates' representations from the two languages might clash at the language level. Arguably, that is the reason the system needs carry out a language decision prior to performing a lexical decision. The conceptual storage of cognates remains to be investigated as well and the question of whether they share the same concept or have two separate concepts for the two items in the cognate pair. Storage at the sublexical, lexical and language levels need to be analysed separately. In this, the storage of identical cognates might prove to differ from the storage of semi–cognates.

As the number of Croatian speakers of Global English rises and the number of English words penetrating the spoken Croatian language increases, studies of bilingual language processing need to account for the issues involved in the processing of cognates. It shall be interesting to learn whether the English words which have penetrated Croatian (e.g. *stick, file, event*) will in the future be processed with the inhibition of the opposite cognate effect, or whether their inclusion into the processing mechanisms of the speakers will follow a different path. This processing ease or difficulty will possibly depend on the degree of their orthographical integration into the Croatian language. Studies of cognates and new penetrations in isolated stimulus representation tasks as well as Croatian sentential contexts should be carried out to investigate the ease with which these two word types are used and processed in different contexts in the Croatian language.

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Procesiranje vidno predstavljenih srodnica u hrvatskih govornika globalnog engleskog

U istraživanju se proučava procesiranje vidno predstavljenih srodnica u hrvatskih govornika globalnog engleskog. Srodnice su riječi koje imaju isti (ili sličan) oblik i značenje u dva jezika govornika (npr. hrv. *problem* i engl. *problem*). Zbog međujezičnih karakteristika koje ovakve riječi dijele, dvojezični govornici na srodnice reagiraju brže nego na nesrodnice (*facilitacijski efekt srodnica*) u zadatku leksičke odluke, a sporije u zadatku jezične odluke (*inhibicijski efekt srodnica*). Lemhöfer & Dijkstra (2004) interpretiraju facilitacijski efekt srodnica u okviru Bilingvalnog interakcijskog aktivacijskog modela + (BIA+) (Dijkstra i van Heuven, 2002) povišenom razinom semantičke aktivacije pri procesiranju srodnica, za razliku od procesiranja nesrodnica, do koje dolazi zbog preklapanja u karakteristikama srodničkih parnjaka. Govornicima globalnog engleskog engleski jezik nije materinski, ali se njime koriste svakodnevno i intenzivno, u obrazovanju, na poslu i u slobodno vrijeme. S obzirom na to da s globalizacijom broj ovakvih govornika u Hrvatskoj iz dana u dan raste, potrebno je izraditi modele jezičnoga procesiranja koji će biti utemeljeni u rezultatima eksperimentalnih istraživanja provedenih s opisanom skupinom govornika.

Ukupno 64 govornika globalnog engleskog pristupila su općemu vidnom zadatku leksičke odluke. Proučavana je interakcija nezavisnih varijabla jezika (hrvatski/engleski), tipa riječi (riječ/pseudoriječ) i srodnica (srodnica/nesrodnica) (dizajn eksperimenta 2x2x2). Analiza varijance pokazala je značajnu trostruku interakciju jezika, tipa riječi i srodnica. Suprotno očekivanomu, pronađen je *obratan efekt srodnica* u reakciji na hrvatske srodnice (vrijeme reakcije na srodnice bilo je sporije nego vrijeme reakcije na nesrodnice), dok razlika u vremenu reakcije na hrvatske pseudosrodnice i pseudonesrodnice nije bilo. U reakciji na engleske srodnice nije pronađena značajna razlika ni u jednoj od ovih vrsta podražaja. Ni analiza pogreške nije pokazala razlike ni u jednom od uvjeta.

Spoznaje ovoga istraživanja o procesiranju srodnica u hrvatskih govornika globalnog engleskog uvrštene su u prilagođenu inačicu BIA+ modela. Značajne prilagodbe u modelu uključuju: lateralnu inhibiciju srodničkih parnjaka unutar istih razina procesiranja, potrebu donošenja odluke o jeziku na razini jezika (koja uvjetuje inhibiciju u procesiranju srodnica) prije donošenja leksičke odluke te inhibicijski utjecaj aktivacije manje vrsnoga jezika govornika (engleskog) na leksičku odluku u vrsnijem (hrvatskom) jeziku.

Key words*:* cognates (lexicology), Global English, Croatian, bilingualism, Bilingual Interactive Activation + model

Ključne riječi*:* srodnice (leksikologija), engleski kao globalni jezik, hrvatski jezik, dvojezičnost, Bilingvalni interaktivni aktivacijski model +